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DEFENSE INTELLIGENCE AGENCY
WASHINGTON, D.C. 20301

MEMORANDUM FOR THE CHAIRMAN, COMIREX
ATTN: [redacted]

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SUBJECT: Viewgraphs for Reproduction

Attached are 24 viewgraphs and text for COMIREX distribution. Please return the aids as soon as possible because they are needed every day for briefings. Also please make 34 copies of aids and text and return to us for inclusion in MCGWG distribution. Thank you.

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2 Enclosures
1. List of Viewgraphs for Reproduction
2. Four pages of VG Text

for [redacted]
Chairman
COMIREX MC&G Working Group

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NRO and DIA review(s) completed.

GROUP 1 Excluded from Automatic Downgrading and Declassification

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Page 1 of 1 pages
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LIST OF VIEWGRAPHS FOR REPRODUCTION

1.	S-23	Results of Mission 1109		
2.	531	Geodetic and Geophysical Components of ICBM CEPS	SECRET	25X1
3.	668	Satellite Data for Worldwide Positioning Milestones		
4.	S-18	Direct Targeting		
5.	659	Initial Tracking Station Coverage w/2 Overlays: 1. Priority Target Areas for KH-4B/ Doppler 2. Typical KH-4B Ground Track	C/NFD (Basic VG)	25X1
6.	S-6	Positioning Capability of Modified KH-4B System		
7.	945-69	Target Position Requirement - Category I Targets	SECRET/NFD	25X1
8.	S-10	Photo Coverage Requirements		
9.	S-11	Photo Coverage Requirements For System Evaluation		
10.	S-12	Photo Coverage Requirements		
11.	D-14	Mission Evaluation		
12.	50164	TRANET SYSTEM	UNCLASSIFIED	
13.		DOPPLER BEACON 1	UNCLASSIFIED	
14.		DOPPLER BEACON 1 GROUND TRACK	UNCLASSIFIED	
15.		ORBIT DIFFERENCES, REV 164-165	UNCLASSIFIED	
16.		DOPPLER BEACON 1 SHORT ARC COMPARISONS IN METERS	UNCLASSIFIED	25X1
17.		CAMERA SYSTEM RELATIONSHIP: TERRAIN & STELLARS		
18.		1109 - DISIC Coverage 0-30% Cloud free		
19.	S-24	Mission Summary Data		
20.	S-22	Ephemeris EVALUATION Absolute Photogrammetric Resection		25X1

TOP SECRET

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21. REV. 32 BAR-XC (1st Overlay)
REV. 91 [redacted]

22. PRELIMINARY RESULTS Magnitude of Residuals

23. D-27R Status of Accuracy Evaluations (90%)

24. S-26 Summary

[redacted]

24 Enclosures a/s

25X1

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Page 2 of 24 Pages
Copy 2 of 3 copies

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VIEWGRAPH TEXTS

1. 1109 was the first Doppler/KH-4 mission. Its purpose was to provide an improved geodetic positioning capability on a worldwide basis to support ballistic missile targeting and to provide control for MC&G programs. The primary requirement is missile target positioning and the emphasis of the briefing will be placed on this aspect although the impact on tactical positioning is significant. The briefing is broken into 2 major categories: 1) background and 2) results of the preliminary analysis by Army, Navy, and Air Force. (VG S-23)

2. This graphic shows the G&G contribution to the ICBM CEP. The component of missile error budget to which mission 1109 was directed is the target position on the World Geodetic System. The 1971 requirement is the accuracy to which the Doppler/KH-4 mission was primarily concerned. (VG #531)

3. This graphic provides a summary of the major decisions and the actions related to the Doppler/KH-4 program. As you will note in November 1968 USIB agreed to program five Doppler/KH-4 missions. (VG #668)

4. The direct targeting approach, which is being used, is illustrated in this graphic. The precise doppler generated ephemeris provides exposure station positions; vehicle orientation is provided through the stellar/ terrain camera relationship and targets are measured on the frame camera. Using this technique positions can be derived for any point on the frame photography. (VG - S-18)

5. This graphic shows the doppler station deployment as planned for mission 1109. Each station with the exception of 895 was in place for this mission. The ellipse around each tracking station indicates the area of visibility down to 2° elevation for a satellite of 100 nautical miles. The ephemeris is determined by tracking the satellite from this worldwide network of stations. (VG #659)

6. Before the decision was made to place the doppler on the KH-4 system a detailed analysis was made of the system's capability for providing geodetic positions. It was estimated that accuracies on the order of those shown could be achieved with the system. (S-6)

7. The primary concern for target positioning was the 1400+ Category I targets. Of this number approximately 43% met the horizontal positioning requirement for 1971. This percentage changes somewhat from time to time but it is generally representative of the situation as it existed before mission 1109. (VG MC-A 945-69)

8. Looking at the specific requirement for 1109 from a graphical point of view we see the approximately 1124 Category I targets which did not meet the accuracy requirements and were submitted for collection. (VG - S-10) 25X1

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Page 1 of 3 pages

TOP SECRET

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9. This graphic depicts the requirements which were submitted for coverage of diagnostic points. These points for which the geodetic positions are known will be utilized to evaluate the accuracy of the system. (VG- S-11).

10. 4753 Category II targets were also submitted for collection. These targets are essentially soft targets and require positioning in the order of 1000'. (VG - S-12) Collection was requested primarily because 2000 of the targets had not been positioned and the direct method is a much easier way of accomplishing the positioning. Also in many cases the Category II targets become Category I targets and as such we wish to have the data available to take care of these contingencies.

11. The evaluation of Mission 1109 consisted of 3 primary areas of analysis:

1. Target coverage - Did mission 1109 attain cloud free coverage for the targets of interest?

2. Adequacy of the stellar photography - do we have enough stars on the plates to provide accurate vehicle attitude.

3. Confirmation of the doppler ephemeris - was the satellite orbit accurately determined for the passes of interest? (VG - D-14)

12. The doppler network which is being used for ephemeris determination is an outgrowth of the Navy TRANET system. This graphic shows the flow of information from the control centers to the field and back again. Orbit alerts, timing information, and station analysis are provided from the Naval Weapons Laboratory through APL to the stations. Stations obtain tracking data and provide the information through the TRANET communication network back to APL who in turn provides the data to NWL for the purpose of ephemeris determination. (VG- File No. 50164)

13. This graphic provides a general analysis of the mission from the point of view of the doppler network. Although the mission was generally very successful some difficulty was experienced in the time frame of 14-18 March due to the deviation of the actual mission from that originally planned. The lack of a DMU firing resulted in some deviation which caused a loss of a little data in this time frame. (VG - NWL)

14. The approach used by Navy in determining the doppler ephemeris was to provide as precise a reduction as possible for each revolution during the mission. In order to provide as precise a solution for each revolution data was taken on the previous and the following revolutions as part of each reduction. As an example, for revolution 134 the data used began with station 106 on revolution 133 and continued through station 121 on revolution 135. This provided significant overlap between each of the revolutions throughout the mission. (VG NWL).

15. One technique for evaluation of the ephemeris accuracy is to compare the fit of the orbits in the overlap areas. This graphic shows the orbital differences between revolution 164 and 165 which happens to be typical. The difference is less than 50 meters. (VG - NWL)

16. This graphic provides a summary of the comparisons of the orbits in the overlap areas. As shown 68% of the total revolutions showed a maximum difference of less than 50 meters. (VG - NWL)

17. Another phase of the mission evaluation is the performance of the stellar cameras and the calibration of the stellar/terrain camera systems. Although the system is calibrated prior to launch, dynamic calibration is necessary after launch to determine if the terrain/stellar camera relationship is changed. This is accomplished by photographing the precise test range in Arizona and comparing the vehicle attitude derived from the precise geodetic points and that determined from the stellar cameras. Dynamic calibration was completed by Army and it has been determined that the initial calibration was satisfactory.

18. This graphic shows the DISIC coverage from mission 1109. As is evidenced from the graphic the mission was an outstanding success, much more successful in fact than can be expected in future missions.

19. This graphic shows the success of the mission translated into satisfaction of target location requirements which were discussed earlier. Of the 1124 Category I targets submitted 901 were covered and had adequate stellar information. Of this number 8 were dropped because of ephemeris difficulty leaving a total of 893 which were satisfied. The additional two rows on the graphic show the success achieved for the diagnostic points and the Category II targets. A word of caution should be injected at this point so as not to be overly optimistic about the success of the mission. It is true that a very large percentage of Category I targets were covered, a large part due to most of the large complex areas being covered. It is not expected that follow-on missions collecting against more scattered targets will be equally as successful. Also there are other requirements such as providing control for the mapping and control data bases which were not priority on mission 1109.

20. The remaining function in terms of the mission evaluation is to examine how the total error combines. This evaluation is accomplished by photographing known ground control and comparing this against the position determined from the direct targeting system.

21. Thus far evaluations have been completed over the Arizona test range and over [redacted] The graphic shows the regions and the orbital revolutions which were used in each of these areas by both Army and Air Force.

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22. This graphic shows the primary results of the Army evaluation in the BAR XC test range area. Based on this preliminary test the differences were 282' Horizontal and 159' Vertical.

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23. This graphic shows the horizontal and vertical differences as derived by ACIC for both of the areas. ACIC results were 130' Horizontal and 170' Vertical for the Arizona test range. In Potsdam the results were 220' Horizontal and 190' Vertical. It should be emphasized at this point that the results thus far were based on preliminary test of only two areas using limited number of points. While the comparisons are very encouraging more extensive evaluation is necessary before overall accuracy of the system can be determined.

24. In summary, it can be said that while some difficulties were experienced, mission 1109 was an outstanding success. Approximately 79% of the Category I targets were covered and approximately 46% of the diagnostic Category II targets were covered. Based on preliminary evaluation it appears that the system can achieve the requirement for target positioning which was established for the 1971 program (450' Horizontal and 300' Vertical). Before the actual system capability is determined much more analyses will be required.